DOCUMENT RESUME

ED 041 396 EA 002 957

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TITLE School System Analysis: An Interaction Process Model.
PUB DATE 4 Mar 70
NOTE 21p.; Paper prepared for American Educational Research Association Annual Meeting, (Minneapolis, Minnesota, March 2-6, 1970)

EDRS PRICE EDRS Price MF-$0.25 HC-$1.15
DESCRIPTORS Academic Achievement, Bureaucracy, Community Characteristics, *Decision Making, Dropout Rate, *Input Output Analysis, *Models, Political Influences, *Public Schools, School Funds, School Policy, Student Characteristics, Student Teacher Relationship, *Systems Analysis, Teacher Characteristics

ABSTRACT

This paper describes informally a comprehensive systems model that could aid school program decision makers. The model, a multistage input-output scheme, permits descriptions of social, political, economic, and educational interactions in an urban school system for the purpose of defining the school system performance and its amenability to change and reform. The model also makes it possible to define levels of financial support given to different schools, and to correlate these findings with student and family characteristics. The model would permit exploration of the interrelationship between various outcomes and inputs, such as student achievement and per pupil expenditures. Description of the demands and supports deriving from a variety of community and political groups is also possible. The model is being applied in Wilmington, Delaware. (Author/DE)

ED041396

SCHOOL SYSTEM ANALYSIS: AN INTERACTION PROCESS MODEL

by

Division of Urban Affairs
University of Delaware*

Minneapolis
March 1970

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EA 002 957

*The work described here is being carried on at the Division of Urban Affairs, University of Delaware. Francis Tannian, an economist, is school project director. James Cox, a political scientist at Urban Affairs; James Elsbery, a sociologist at the Center for Urban Education, New York; Jon Magoon of the College of Education, University of Delaware; and Shigeo Nohara of the Department of Sociology, University of Delaware, combined with Francis Tannian to develop the model. This paper has been written by Jon Magoon and Francis Tannian.

City school policymakers work in a high stress environment. Schools are only one part of a larger scene for hotly contested social change. Demands on city schools go far beyond the classic 3R's or reading and math skill improvement. Demands press in on the schools to get involved with job markets, social change, sex education, and even police youth work. The question is just how far will schools go in replacing functions normally the responsibility of the family. When communities decide that schools should attempt to meet these wider and non-conventional demands much of the independence school systems have tried to achieve simultaneously comes under attack. When schools move to take up functions performed by the family, family demands to be involved in school policy can be expected to grow rapidly.

Moreover, as pressures for new programs mount, added school funding is requested. But the schools must compete in the sweepstakes for city budget shares against requests for added police protection, advancing requirements for pollution control and cost erosions due to inflation. These and other nonschool factors bid for added city revenues which come chiefly from the same pool of counter-productive city property taxes.

In a systems analysis sense city school demands are but one element of local public policy demands competing for shares of public revenues. Optimum social policy would lead a city to provide the most valuable mix of schools, fire protection, snow removal, and many other community goods by using up the least valuable amounts of city resources. Similarly within the complex subsystem which is the city school program, the hope must be to make decisions which generate the most valuable services at lowest burdens to the community.

One purpose of this paper is to outline a comprehensive school system model which, when put into operation, could aid school program decision makers. A second purpose is to briefly point out the utility along with some of the difficulties of this systems approach. The model described is being applied in Wilmington, Delaware.[1] It has grown out of a series of completed analyses of other municipal functions (water supply, parking, etc.), where again the emphasis was upon model applications to aid decision making.

An important research precedent for our work is the limited input/output model for city school systems (by Jesse Burkhead). The purpose of Burkhead's model was to (1) examine resource allocation within school systems and tie this to educational outcomes, (2) measure and study many factors that affect educational outcomes, and (3) give operational definition to input/output variables.[2]

The effect of several kinds of constraints left Burkhead with approximately four output and ten input variables that were measurable. (These are listed in Table I.) Nevertheless, the model enjoyed limited success, for outputs could be predicted utilizing a linear prediction scheme. The most predictable outputs were test scores, being highly dependent on the socioeconomic status of pupils. Post high school plans and dropout rates were less highly predictable, and administrative variables were simply unimportant insofar as these outputs were

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[1]In 1954 the Wilmington Public Schools were segregated white and black. In 1970 these same schools are becoming, like the city's resident population, predominately black. Nationally, Wilmington is second only to Washington, D.C. among central cities in the proportion of nonwhite students in the public schools.

[2]Burkhead noted that the central weakness of any input/output model of the educational process, including his own, derives from the fact that psychological learning theory as yet provides too unstable a foundation for a systems model. This fact of life necessarily limits any model to being descriptive in nature, rather than focusing on the study of causal relationships.

TABLE I

Burkhead's Input/Output Model Variables (Chicago)

Inputs	Outputs
1. Median Family Income	1. 11th Grade I.Q.
2. Average Daily Attendance	2. 11th Grade Reading
3. Age of School Building	3. Dropout Rate.
4. Textbook Expenditures	4. Post-High School Intentions
5. Materials and Supplies Expenditures per Pupil	
6. Teacher Experience	
7. Number of Master's Degrees	
8. Teacher Man-Years per Pupil	
9. Administrative Man-Years per Pupils	
10. Auxiliary Man-Years per Pupil	

concerned. Burkhead's model application demonstrates that school systems can be studied by input/output techniques.

The model outlined here describes sociological, political, economic, and educational interactions in an urban school system in order to describe how the system is performing and might be amenable to change and reform.[1] To do this it is necessary to take into account both how the system operates and how changes can be brought about. Unlike most previous educational systems models, this one is aimed at having direct practical utility to educational administrators and local educational interest groups in a specific small city situation.

The school system model described here can be generally characterized as a multistage input/output scheme. The model structure has borrowed heavily from work of various people in many disciplines. Among the major work, including Burkhead, from which ideas have been adopted are Coleman's model for identifying predictors of student achievement, Easton's systems analyses for describing policymaking, and Gamson's sociological notion of trust as relates to community policy. The debt we owe to the work of these and to others will be seen in our model-which is outlined below in Figure 1.

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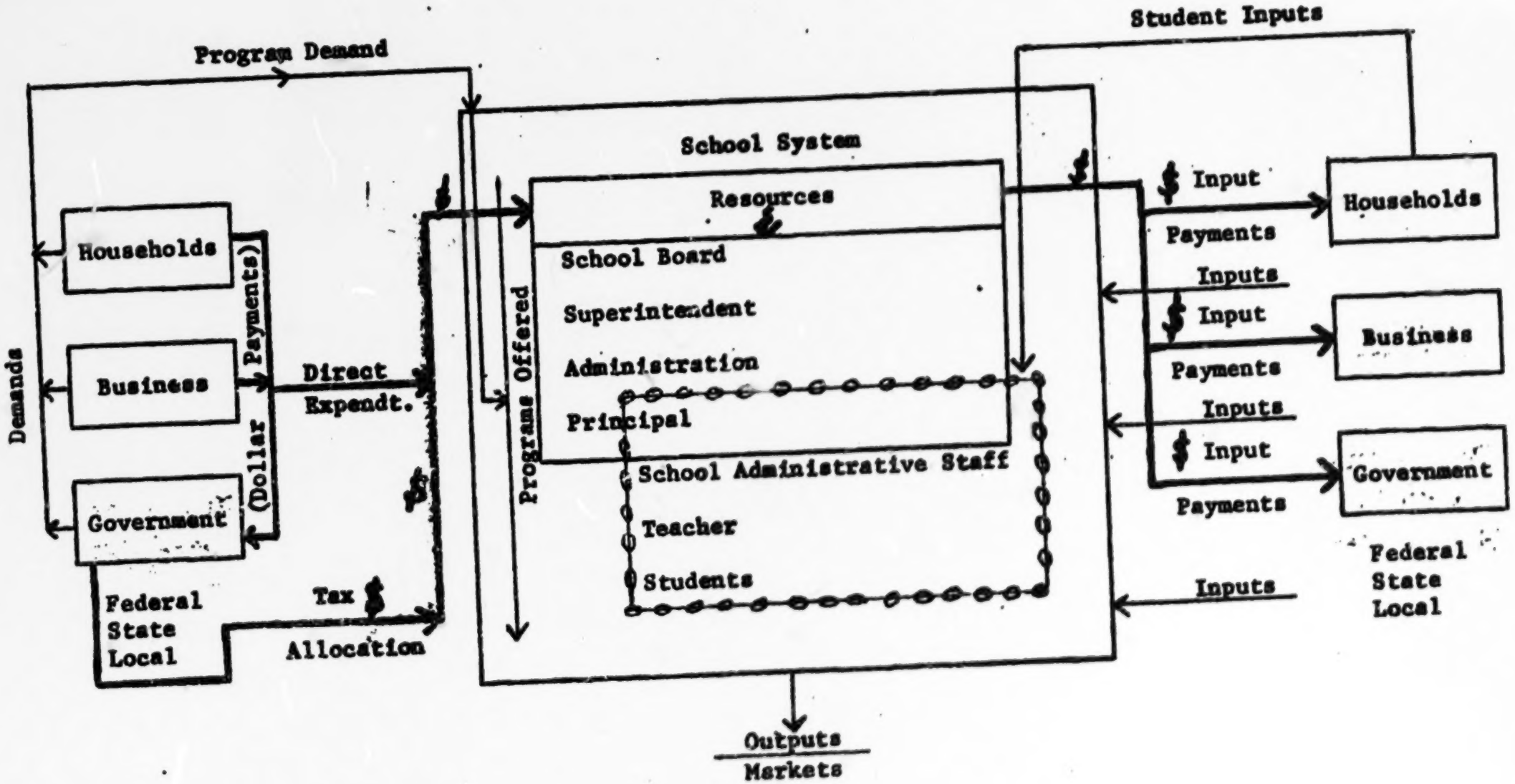
[1]Our approach assumes school administrators or interested community groups wish to institute innovations and change, but the realities of public school administration go far beyond a 12 variable model. Limited models of school systems have often provided little information as to how day-to-day processes occur or how changes may be brought about. It can be assumed that such reforms and innovations are of critical importance, for urban schools are perceived as not measuring up to many expectations and new approaches to urban education seem well advised. In seeking to develop a model for urban school systems that has high utility for both educational administrators and community leaders, it is maintained that the school system and its sociological, economic, and political workings must be explicated. One specific focus of such a model should be the mechanisms by which reforms and innovations can be initiated.

SCHOOL SYSTEM INTERACTION PROCESSES MODEL FRAMEWORK



LEGEND

——— Money Flows

——— Demand-Supply Elements

⊶⊶⊶ Individual Schools

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Households provide student inputs (right side of Figure 1) which are processed over a series of years in the school system by a series of programs. Ultimately these boys and girls graduate out or drop out of the school program after passing a series of grades where achievement goals are met. Simultaneously governmental, business, and household groups maintain various program demands on the school system. Households and businesses back up these demands with money payments. Legal steps are taken allowing federal, state, and local governments to collect moneys (heavy lines in Figure 1) through a variety of taxes and then allocate the funds back to the school system for use. Private support in terms of corporation grants or personal bequests provide some supplementary funds.

These financial resources are then spent back into the community in terms of payments to business for books, paper, and electricity in terms of salaries to teachers, and less often in terms of user charges to governments for services such as water or police protection. Top echelons of the school system guide this spending and buy a mix of various resources which are allocated down to individual schools. At this stage money flows become cost functions.

The central block of Figure 1, labeled "School System," can be viewed as the decision-making structure which guides the funds it receives, listens to various demands for programs, accepts the student inputs and actually manages programs offered. Operating responsibility for the present and planning responsibility for the future rests with this formal organization or bureaucracy.

Principals of individual schools behave as middlemen to some extent between schools and the bureaucracy. The dotted lines within the larger school system block of Figure 1 represent individual schools where the central business of education is carried out through teacher to student interactions.

The model suggests that systematic school policy decision making requires measurement and understanding of at least: student inputs, teacher-student

interactions, bureaucratic processes, funding arrangements, expenditure patterns, program demands, physical input mixes, and output performance including the relationship of student skills to job market characteristics of the local economy.

The general processes model described can be operationalized by measuring the factors such as costs, inputs, and demands specified by the model.

First in many senses are the students. Clearly numbers of students are important, school by school, as is age, race, and sex of the students. Such information is readily available. SES characteristics of the student's family as perceived by the student, student self-concept, perceptions of school, career aspirations, reading achievement and arithmetic achievement will also be measured. The goal is to be able to describe the student body in a quantitative and qualitative fashion.

The community environment from which students come to the schools will be quantified through neighborhood characteristics and student family factors. Attitudes of parents toward the schools including appraisal of school goals and descriptions of program demands are being measured. The role of families in political life of the city and social life of immediate neighborhoods is being described.

Not only are quality measures of public school families and neighborhoods being described but similar measures of nonpublic school student families and for families with no school children are being developed. In a system sense all family units of the city must be included. Perceptions of public school performance by parochial school families promise to yield interesting information as to neighborhood structure differences and school program demands as contrasted to public school families.

Moving away still further from the direct environment of the classroom, school policy effectiveness and community satisfaction relates to the complex general policymaking environment of the community. Attempts are being made to identify the nature of political decision making networks in the city. Participation of various party officials, union leaders, bankers and spokesmen for various racial groups in school policy decision making will be described. Levels of demands and supports for various school policies by these leader groups will be identified.

Within the school system, itself, (see Figure 1, central block) the key persons directly able to affect student performance are the teachers. Age, sex, race, education, and teaching experience are some standard qualitative characteristics of teachers being quantified. But just as students enter and pass through the educational process under the influence of family and neighborhood characteristics, all of which must be taken into account by school policymakers; so also teacher performance is affected by a complex set of backup factors. These backup factors can be called the school organization or bureaucracy. Program policy changes, information about salaries, day-to-day communications and rumors circulate between classes, within schools, between schools, to the administrative staff "downtown," through to members on the school board in a series of formal and informal ways. The nature of these channels structures the nature of how decisions get processed. Through observation and interview techniques the structure of these functions is being identified.

Data and verbal information is being collected to quantify how teachers perceive their goals and school system rewards. What information teachers have about the community from which their students come is also being measured along with teacher attitudes toward classroom control and race. Persons in the

administration such as supervisors and principals will be interviewed to determine how they perceive communication patterns, what goals they have for the immediate future and longer term. The aim is also to identify the levels of demand and support for various school programs by persons in the bureaucracy.

Budget processes and spending processes for operations and physical plant are being studied along with the nature of state, federal, and local school funding that makes spending possible. Cost ratios for individual schools are being established.

Performance or output measures will also be attempted. Reading achievement and math achievement scores are viewed as intermediate output indicators. Dropouts, numbers of graduates, and ability of both dropouts and graduates to perform in the region as workers or as students in advanced educational programs are being traced out.

The conceptual difficulties of operationalizing each of the steps described above are formidable. Many of the measures are exploratory. For example, to our knowledge relationships described in the theory of bureaucracy have not been empirically tested. Critics with an eye to statistical fine tuning may find little praise for many of the adaptations we are being forced to make. Nevertheless, we are now getting measurement of all the major variables described by the model.

Just as problemsome as the major steps of (1) building the model, (2) constructing ways to operationalize the model and (3) actually measuring the variables is the matter of releasing results once they have been gathered.

Here we face many problems such as the timing of information release and the sequence of releases. Who in the community should get the findings and what form should these releases take? We are considering holding several two-day sessions where family people, school administrators, businessmen, students, and members of

our research team gather to review what these measures of this school system mean and what they might suggest for policy. Clearly we believe the standard professionalized report simply is not enough.

Our goal is to provide a description of the processes at work in the school system overall. Particular types of processes (e.g. bureaucratic perceptions) are thought to be related to other inputs or processes (e.g. community demands), and it is the intention of this study to describe these relationships as fully as the data allows. We are not content to simply characterize the system as a theoretical multistage input/output mechanism. The information gathered should be of practical utility to those concerned with an evolving school system; as incentive for such involvement we want to open up the information to all sectors of the community before issuing a final report. By providing data, analyses, and information to a community and school administration we would hope they could together review such information and find agreement on prescriptions for reforms somewhat easier to reach.

APPENDIX

A Partial List of Variables and a Methodological Approach

The general process model can be operationalized by measuring variables describing several aspects of the school system and its environment. We have chosen six in the study: (1) pupil achievement; (2) the community; (3) the bureaucracy; (4) the political elites; (5) the teacher; and (6) economic resource allocation. One analytical approach which would seem to warrant attention would be the analysis of the relationships between dependent variables in each area and independent variables both within and beyond these particular areas (e.g., to what extent is pupil achievement dependent upon differential resource allocation between schools in the system?). These sets of variables described represent a partial listing of those defined in this study.

The first element of the general process model is student achievement, the prime focus for the educational system. Achievement has been given operational definition by a series of locally-developed measures of attitudinal achievement and a typical standardized achievement battery. Relative achievement partitioned by various school boundaries will be reported, but this information is not new or especially informative for many reasons. Achievement and other background data may be cast into an analytical design, e.g. multiple regression analysis with predictors as outlined on the left in Table II and criteria (achievement) on the right. Ideally variation in the achievement measures should not be attributable to prior variation in those same measures and hence the effect of this prior achievement should be partialled out (e.g., partial regression or covariance). Among the predictor which are projected to relate strongly to achievement are family anomia

TABLE II

Pupil Achievement Variables

Achievement Predictors	Achievement
1. Pupil Age, Sex, Race	1. Academic
2. Prior Pupil Achievement	Mathematics Reading
3. Per Pupil Expenditures	Science Social Studies
4. Socio-economic Status	Spelling
5. Family Anomia	2. Attitudinal
6. Family informedness	Academic Motivation Academic Self Concept
7. Family Initiative	Career Aspirations Control of Environment
8. Family Satisfaction with Schools	Social Self Concept Valuation of School
9. Family Support for Schools	
10. Teacher Evaluation of School	
11. Teacher Evaluation of Students	
12. Teacher Commitment to Schools	
13. Teacher Instructional Style	
14. Teacher Quality	

(sense of normlessness) and support for the schools, and teacher evaluation of the school and students. These relationships will be studied within grade levels where the number of families sampled will not exceed three hundred.

Table III focuses on the domain of teacher satisfaction, and identifies potential predictors of such satisfaction. Satisfaction is though to encompass a variety of perceptions on the part of the teacher, including teaching in general, pupil quality and malleability, educational facilities and within-system supports, and community support for educational programs. These measures are embedded in a questionnaire survey which most teachers in the school system are expected to complete. This survey also measures backgroumd information on the teachers concerning their own level of education, their socio-economic origins, their relative permissiveness in their relationships with students, and their instructional mode of operation. Other factors that are predicted to affect teacher satisfaction are the relative achievement levels of pupils they come into contact with, relative pupil ethnic differences, differences in pupil socio-economic status, and a series of measures of social and political impact that the community, defined by the local school attendance boundary, has on the school.

A set of variables which serves to define several aspects of the school system bureaucracy is found in Table IV. A survey instrument will assess bureaucratic perceptions of policy decision making networks in the city. The essential question in the educational bureaucracy area concerns how receptive the school administration is to demands from groups outside the formal system. To assess this aspect bureaucratic perceptions, measures of bureaucrat's political efficacy, trust in community power arrangements flexibility, and perceived supports for educational reforms and innovations

TABLE III

Teacher Satisfaction Variables

Predictors of Satisfaction	Satisfaction
1. Pupil Achievement	1. Teaching
2. Pupil ethnic Differences	2. Pupil Quality
3. Pupil Socio-economic Status	3. Educational Facilities
4. Community	4. Effectiveness of School Program
Anomia	5. Bureaucracy
Informedness	
Initiative	6. General School System
Satisfaction	
Support	7. Support from Community
5. Teacher	
Age	
Sex	
Level of Education	
Instructional Style	
Educational Values	
Receptivety to Community	
Innovativeness	
Socio-economic Background	

TABLE IV

Bureaucracy Variables

Bureaucratic Perceptions of the School System

Situational Determinants Of Bureaucratic Perceptions	Perceptions of the System
1. Bureaucrats Position	1. School System Goals
2. Bureaucrats Function	2. School System Demands
3. Bureaucrats Rank	3. Bureaucratic Support Levels
4. Bureaucrats Perceptions	4. Difficulty of Communication
Teacher Demands Student quality Teacher Quality Community Quality System Quality	5. Effectiveness of Supt. Cabinet
	6. Adequacy of School Supports
	7. Flexibility
	8. Political Efficacy
	9. Trust in Community Power Arrangements

will be measured. Bureaucrats also are believed to respond strongly to other bureaucrats, so various measures of this type of interaction will be made including communication difficulties, bureaucratic support levels, and perceived effectiveness of key administrators. To some extent these bureaucratic perceptions are expected to be reflections of the rank and function of the respondent. In addition, bureaucrats' perceptions of the administrative system are hypothesized to depend to a limited extent on perceived teacher demands, and student and community quality.

The costs of education and the constraints on budgetary allocations are described in Table V. The resource allocation constraints are viewed as descriptors of an economic constraint network rather than as predictors of costs. The constraint network not only describes school system formulae, but reaches beyond to teacher, community, and bureaucratic influences on revenue spending. Costs are seen as a variety of measures, extending further than per pupil costs, personnel costs, building costs, bond issue costs, and special program costs which are the typical concerns of school system administrators. Included in costs for this analysis will be such measures as the dropout rate, graduate unemployment rate, teacher turnover rate, and an estimate of the worth of the school systems graduate products as viewed by local business operations and institutions of higher learning.

The variables collected in Table VI might again be placed in an independent-dependent variable framework for analysis of the concept of political trust. Political trust could be roughly defined by the withholding of pressure or influence from the political target even though there exists a strong sense of political efficacy. To guage the degree of trust a community has in the school system there must exist sufficient information about the interest in

TABLE V

Resource Allocation Variables

A Description of School System Spending Patterns

Resource Allocation Constraints	Cost Allocations
1. System Budgeting Formulae	1. Per Pupil Cost
2. Sources of Revenues	2. Personnel Costs
3. Personnel Variables	3. Building Costs
4. Sociological Community Variables	4. Dropout Rate
5. Teacher Satisfaction	5. Teacher Turnover Rate
6. Bureaucratic Role Behavior	6. Vocational Instructional Costs
	7. Graduate Unemployment rate
	8. Bond Issue Costs

Table VI

Community Trust Variables

A Community Estimate of Trust in the School System

Determinants of Community Trust	Components of Trust
1. Relative age of family	1. Information level
2. Race	2. School Affect level
3. Socio-economic status of family	3. Initiation of action
4. Socio-economic status of reference group	4. School support
5. Anomia	5. Political Efficacy
6. Frequency of Educational contacts	6. Political Alienation
7. Formal group memberships	7. Political Polarization
8. Communication channels	

school matters. To assess these latter attitudes a questionnaire given to 1500 selected community members will measure their information level, school affect level, political alienation, and political polarization. The relationship of these community attitudes to socio-economic and other indices of social involvement listed on the left of Table VI will allow for an indentification of present determinants of political trust. Most important among these are the indices of social contact with the schools, the influence of various group memberships, and the impact of varing sources of information on perceptions of the school system.

Table VII indicates the operational measures which will be applied to a group of political elites in the community. The political elites in the community are the leaders whose views must be taken into account in many educational policy decisions. The main purpose of this aspect of the school system study is to determine the relative political influence of each leader. This will be done by interviewing leaders and determining their perception of the influence hierarchy and the reasons for this. Both the reasons that leaders give for their perceptions of another's influence and situational leadership connections will be systematically evaluated with respect to the list of variables on the left. The overriding interest in the relationship of these predictors to leader influence is to determine the relative openness of the leadership to demands arising from other sources.

TABLE VII

Political Elites Variables

The Perceptions of a Sample of Community Leaders

Predictor of Leader Potency	Political Leadership in School Affairs
1. Friendship ties	1. Political Influence
2. Frequency of Contact	2. Leadership Ranking
3. Mode of Interaction	3. Political Interaction
4. Reciprocal Support	
5. Functional interests	
6. Professional Role	
7. Organizational Memberships	
8. Organizational Orientation	
9. Involvement (school matters)	
10. Poittical Activity	
11. Satisfaction (school system)	